Kindergarten Vaccination Coverage Survey

School Year 2015-2016

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Executive Summary

Overview

The Kansas Certificates of Vaccinations (KCIs) and other vaccination records for children enrolled in a kindergarten class in Kansas public and private schools during the 2015-2016 school year were collected and vaccination coverage was evaluated for all required and recommended vaccines. Vaccination coverage levels were calculated for children at the time of school entry (i.e., on the first day of school for the 2015-2016 academic year) and 30 days following school entry. Children who were between the ages of five and seven years on the first day of the school year were included in the study. In total, there were 356 schools, 302 public and 54 private, included in the analysis, which consisted of a representative sample of 8,328 students.

Vaccination Coverage for Kansas Kindergarteners

The statewide coverage levels at school entry for all vaccinations required for school entry were above 87%, with HepB3 having the highest coverage at 96.8%. DTaP4 and HepB3 were the only vaccinations which met national metrics [Healthy People (HP) 2020] of at least 95% coverage among kindergarteners. The 5-4-2-2-3 series measures for all five required vaccinations and had a coverage level of 83.4% at school entry. A two percent increase in DTaP5, Polio4, MMR2, Var2, and 5-4-2-2-3 series was observed 30 days after school entry. When coverage levels were examined by type of school (private v. public), no significant differences were observed. Similarly, 2015-2016 coverage rates were compared to the previous school year and no significant changes were observed. Kansas counties were grouped based on population density (rural, moderately populated, and urban) and coverage assessed. Sparsely populated counties had the highest coverage level for the three non-required vaccines (Hib3, PCV4, and HepA2). Urban counties had significantly lower vaccination coverage Polio4, HepB3, and 5-4-2-2-3 vaccine series when compared to moderately populated counties. Rural counties had significantly higher coverage levels for Hib3 and PCV4 compared to any other group.

Exemption and Exclusion Policies

Kansas allows two forms of vaccine exemption; religious and medical. Of the 1.7% of kindergarten students reporting an exemption, a majority were religious. The percentage of religious exemptions was 1.4%; significantly higher than the previous academic year. A majority of schools (72.0%) had a policy in place which allowed children time to get caught up on vaccinations; while 17.0% reported having no grace period policies and 11.0% required children be UTD at school entry. Public schools most commonly allowed children 90 days to become UTD (17.1%), while a majority of private schools required children be UTD on the first day of school (22.1%). Schools which excluded children from attendance who were not UTD had significantly higher vaccination coverage for DTaP5, MMR2, Var2, and 5-4-2-2-3 series compared to schools which did not exclude non-UTD students.

Background

The Kansas Kindergarten Immunization Coverage Assessment is an annual survey conducted by the Kansas Department of Health and Environment (KDHE) to assess vaccination coverage among kindergarten students. The population for this study included kindergarten students between the ages of five and seven years on the first day of the academic year and enrolled in either a public or private school in Kansas.

The Advisory Committee for Immunization Practices (ACIP) recommends children by 5 years of age receive (Table 1):

- 5 doses of diphtheria, tetanus, and acellular pertussis vaccine (DTaP5)
- 3 doses of hepatitis B vaccine (HepB3)
- 3 doses of *Haemophilus influenzae* type b vaccine (Hib3)
- 2 doses of measles, mumps, and rubella vaccine (MMR2)
- 4 doses of pneumococcal conjugate vaccine (PCV4)
- 4 doses of polio vaccine (Polio4)
- 2 doses of hepatitis A vaccine (HepA2)

DTaP was first licensed in 1996. By 1998 ACIP recommended administration of DTaP instead of the diphtheria, tetanus and whole cellular pertussis (DTP) vaccine for immunization due to fewer reactions[1]. Kansas requires all children entering kindergarten have five doses of DTaP, with proof of immunization provided to school prior to first day of attendance[2]. Four doses of DTaP is acceptable if the fourth dose was given on or after the child's fourth birthday. Hepatitis A vaccine was first licensed in 1995 and in 2006 ACIP recommended administration of this vaccine to all children[3]. In 2009 Kansas required those in childcare have two doses of hepatitis A vaccine; however, it is not required for entry into kindergarten. Hepatitis B vaccine was first licensed in 1981 and by 1991 ACIP recommended administration of this vaccine to all infants. In 2004 Kansas required all children entering kindergarten have three doses of hepatitis B vaccine. *Haemophilus influenzae* type vaccine was first licensed in 1985. In 1991 ACIP recommended it for infants beginning at two months of age. Hib3 is not required for entry into kindergarten. Measles, mumps, and rubella vaccine was first licensed in 1971, two doses of this vaccine was recommended for all school-aged children by 1989. Kansas requires children to receive two doses prior to entering kindergarten. Pneumococcal conjugate vaccine was first licensed in 1977. In 2000 it was licensed for use in infants and by 2010 ACIP recommended for infants starting at two months of age. Kansas does not require

[1] Preventing Tetanus, Diphtheria, and Pertussis Among Adolescents: Use of Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccines Recommendations of the Advisory Committee on Immunization Practices (ACIP)

[2] Immunization Action Coalition. State Information State mandates on immunization

[3] Epidemiology and Prevention of Vaccine-Preventable Diseases. 13th ed.

PCV4 for kindergarten entry. Polio vaccine was first licensed in 1955 and later that year doses were distributed throughout the United States. Kansas requires all children entering school to have four doses of polio vaccine. Three doses are acceptable if the third dose was given on or after the child's fourth birthday. Varicella vaccine was first licensed in 1995. By 2006 ACIP recommended a second dose of varicella vaccine for all children. Kansas requires children entering kindergarten to have two doses of varicella vaccination. A vaccination schedule per ACIP recommendations is found in Appendix 5.

Table 1: ACIP Birth to 6 Years Immunization Recommendations

		Requirement for School	Number of Doses	Healthy People 2020 Coverage Goals
DTaP5	Diphtheria, Tetanus, Pertussis	Yes	5	95%
DTaP4*			4	
HepB3*	Hepatitis B		3	
MMR2*	Measles, Mumps, Rubella		2	
Polio4	Polio		4	
Polio3*			3	
Var2*	Varicella	Yes (or history of disease)	2	
5-4-2-2-3	DTaP5, Polio4, MMR2, Var2, Hep3			
HepA2	Hepatitis A	Recommended	2	
Hib3	*Haemophilus influenzae* type b		3	
PCV4	Pneumococcal conjugate vaccine		4	

In the state of Kansas, two legal alternatives to vaccination at school entry exist, medical exemption and religious exemption.[4] To receive a medical exemption, a physician must annually sign a form stating the reason for exemption and from which vaccine(s) the child is exempt. To receive a religious exemption, a parent or guardian must write a statement explaining that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. Another statute (K.S.A. 72-5211a) allows schools to exclude students from school who are not UTD for required vaccinations. However, it is entirely up to the school board as

[4] Statute 72-5209: Same; certification of completion required, alternatives; duties of school boards. (a) In each school year, every pupil enrolling or enrolled in any school for the first time in this state, and each child enrolling or enrolled for the first time in a preschool or day care program operated by a school, and such other pupils as may be designated by the secretary, prior to admission to and attendance at school, shall present to the appropriate school board certification from a physician or local health department that the pupil has received such tests and inoculations as are deemed necessary by the secretary by such means as are approved by the secretary. Pupils who have not completed the required inoculations may enroll or remain enrolled while completing the required inoculations if a physician or local health department certifies that the pupil has received the most recent appropriate inoculations in all required series. Failure to timely complete all required series shall be deemed non-compliance. (b) As an alternative to the certification required under subsection (a), a pupil shall present: (1) An annual written statement signed by a licensed physician stating the physical condition of the child to be such that the tests or inoculations would seriously endanger the life or health of the child, or (2) a written statement signed by one parent or guardian that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. (c) On or before May 15 of each school year, the school board of every school affected by this act shall notify the parents or guardians of all known pupils who are enrolled or who will be enrolling in the school of the provisions this act and any policy regarding the implementation of the provisions of this act adopted by the school board. (d) If a pupil transfers from one school to another, the school from which the pupil transfers shall forward with the pupil's transcript the certification or statement showing evidence of compliance with the requirements of this act to the school to which the pupil transfers.

to whether or not to enforce K.S.A. 72-5211a until a child becomes UTD on vaccinations required for school entry.

Methods

Immunization Coverage Analysis

Each Kansas public and private school with a kindergarten class received a letter requesting their participation in this study. These letters, co-signed by the Secretary of KDHE and the Commissioner of the Kansas State Department of Education (KSDE), specified the number of records requested based upon the simple random sampling technique and kindergarten enrollment population. This sampling technique was used to generate adequate sample size for each Kansas County. Sampling weights were calculated based on county size and school type (public or private). Schools were assigned to one of three groups:

- Schools that sent 30 vaccination records selected at random
- Schools that sent all vaccination records
    - Schools with less than 30 kindergarten students
- Schools that sent no vaccination records

These record requests could include exemptions based on how records were requested to be selected. Participating schools could submit Kansas Certificates of Immunizations (KCIs) or any other form of paper vaccination record, including printouts from computerized record keeping programs, to KDHE. All personal identifiers were removed from records, except date of birth, to ensure confidentiality. This sampling methodology is different from assessments prior to the 2014-2015 school year, so data from previous years cannot be utilized for comparison. To be included in analysis, data had be received by a set cut-off date, as indicated on the participation letter; additionally, data could not be utilized if date of birth was missing or date of vaccine administration was illegible.

Data Analysis

Consistent with previous studies, total population included children with date of birth on vaccination data source that met age requirements for inclusion. Point estimates of coverage levels and 95% confidence intervals (95% CI) were analyzed for:

1. Vaccinations required for school
    - DTaP5, Polio4, MMR2, HepB3 and Var2
2. Vaccinations recommended for school
    - Hib3, PCV4 and HepA2
3. Healthy People 2020 (HP2020) objectives
    - DTaP4 and Polio3

If a child had a fourth dose of DTaP on or after the fourth birthday, he/she was considered UTD for DTaP5 school requirement. A child was considered UTD for Polio4 if he/she had a third dose of the vaccine on or after the fourth birthday. Additionally, children who indicated history of varicella disease were not included in the analysis for varicella vaccine coverage. Reports of vaccination exemptions were classified as medical, religious or non-exempt.

Analyses were performed at school entry and used weighted data, which accounted for the complex sample design effect due to the stratification by school type and county. Sample weights were calculated using the number of kindergartners enrolled in a county and the number of records analyzed for that county. The counties were categorized based on population densities, and for the purpose of this analysis, counties were grouped into "urban" (≥150 persons per square mile), "moderately populated" (20-149.9 persons per square mile), and "rural" (≤19.9 persons per square mile) (Appendix 1). Vaccination coverage level estimates were compared among these groups.

Exemption and Exclusion Policy Analysis

Data Collection

Each Kansas public and private school with a kindergarten class received a letter requesting their participation in this study. These letters, co-signed by the Secretary of KDHE and the Commissioner of the KSDE, requested schools to complete a form or online survey listing:

- Total number of kindergarten students enrolled
- Total number of kindergarten students with exemptions to vaccination by type (religious or medical)
    - Students with exemption to all vaccines
    - Students with exemption, who have one or more vaccinations

Additionally, schools were asked to complete a two-question survey assessing exclusion policies and procedures.

Data Analysis

Exemption data was collected regarding the total number of kindergarten students enrolled who had any type of exemption and were classified by type (religious or medical). Exemptions were categorized as either full exemptions or partial exemptions, denoting whether or not the exemption was applied to all vaccines or only some. All exemptions were analyzed by school type (public or private) and county population density group (sparsely populated, moderately populated, or urban).

School policy data was collected regarding enforcement of K.S.A. 72-5211a and policies were stratified by school type.

Data regarding school exclusion policies were linked with vaccination records from corresponding schools utilized in the coverage assessment analysis. Point estimates of coverage levels and 95% CIs at school entry were calculated for the coverage assessment analysis and were stratified by school exclusion policy.

Results

Coverage Assessment Analysis

Data Collection

Letters of invitation to participate in the coverage assessment were sent to 378 Kansas schools; 315 were public schools and 63 were private. These schools were asked to provide vaccination records for a specific number of students. Twenty-two schools (5.8%) did not respond, did not respond in time, or provided unusable data. The remaining 356 schools (302 public and 54 private) that responded to the data request, provided 8,328 vaccination records that were included in the analysis. This corresponds to a school participation of 94.2% and is equivalent to one record representing 4.4 students enrolled in participating schools.

The sample population for the 2015-2016 school year enrollment distribution across the state of Kansas was 35.6% in sparsely populated counties, 48.0% in moderately populated counties, and 16.5% in urban counties. After weighting, the number of records included in analysis were:

Rural: 2,961 (11.9%) Moderately populated: 3,994 (32.5%) Urban: 1,373 (55.6%)

Kindergarten Vaccination Coverage

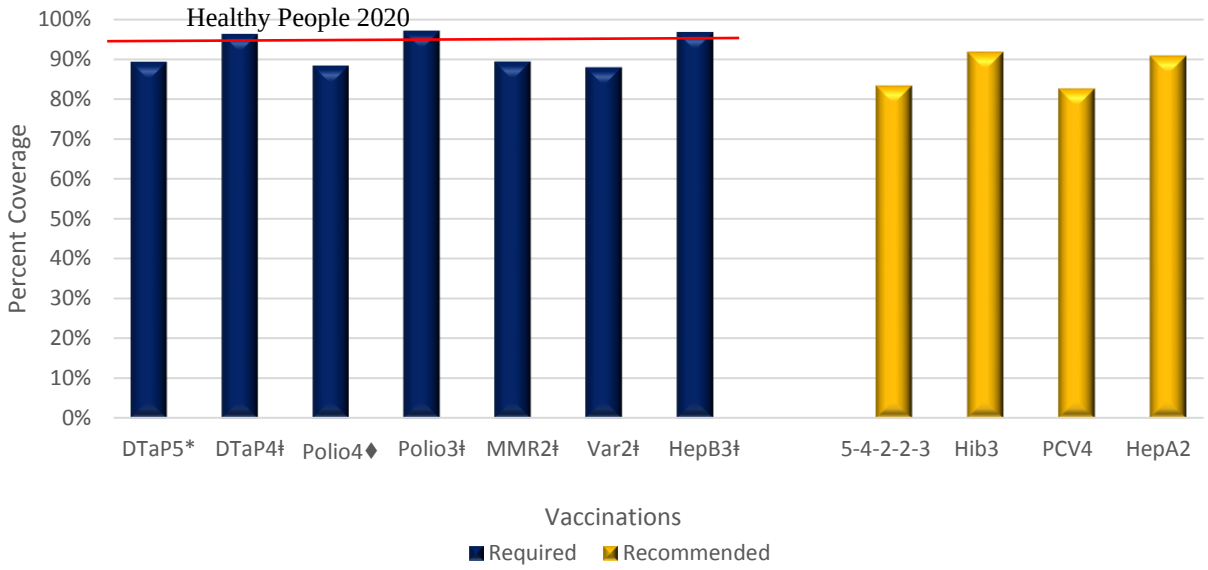
Statewide Vaccination Coverage

The vaccination coverage levels at school entry of all required vaccinations (DTaP5, Polio4, MMR2, Var2, and HepB3) were above 87%, with HepB3 having the highest coverage of any vaccination at 96.8%. Var2 had the lowest coverage among required vaccinations with 87.5% of children being fully vaccinated. The complete series for all five required vaccinations (5-4-2-2-3) had a coverage level of 83.3%. Of the vaccinations not required for school entry, PCV4 had the lowest coverage with 82.6% of kindergartners fully vaccinated at school entry. Statewide coverage for DTaP4 (96.4%), Polio3 (97.1%), and HepB3 (96.8%) exceeded the HP2020 national metrics (Figure 1). The state of Kansas follows different metrics to determine UTD status compared to the HP2020 goals.[5]

The vaccination coverage levels of kindergartners were significantly higher for most required vaccinations (DTaP5, Polio4, MMR2, and Var2) as well as the 5-4-2-2-3 vaccine series when comparing coverage levels from school entry to those 30 days following the first day of school (Figure 2). The only required vaccination that did not have a significantly increased coverage level was HepB3. Additionally, the coverage levels for the three non-required vaccinations (Hib3, PCV4, and HepA2) did not significantly increase after the first 30 days of school.

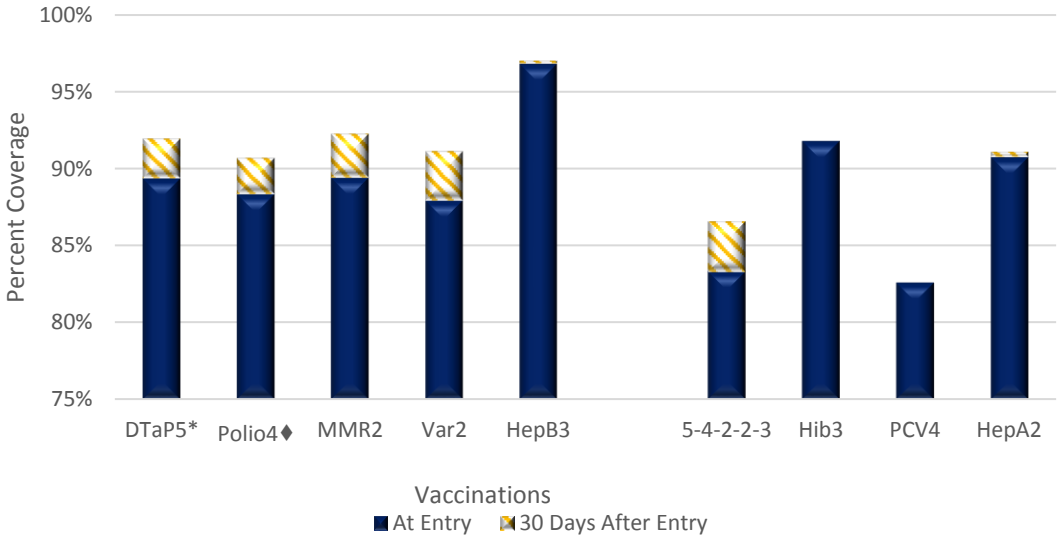
[5] Healthy People 2020 (http://www.healthypeople.gov)

Figure 1: Statewide vaccination coverage levels of kindergarten students at school entry, Kansas 2015-2016



**5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.*
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday
‡ Healthy People 2020 objective

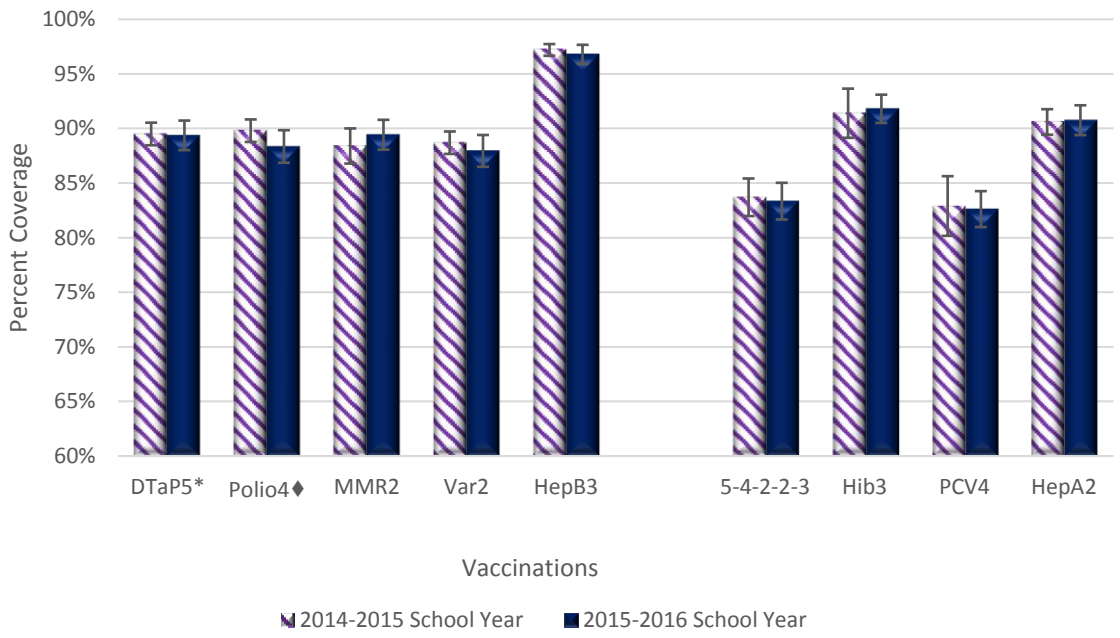
Figure 2: Statewide vaccination coverage levels of kindergarten students 30 days after school entry by vaccine, Kansas, 2015-2016



**5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.*
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday

Vaccination coverage among Kansas kindergarten students at school entry was compared to coverage levels from the previous academic year. Comparisons revealed no significant changes in vaccination levels between 2014-2015 and 2015-2016 academic years (Figure 3).

Figure 3: Statewide vaccination coverage levels of kindergarten students at school entry by vaccine, Kansas, 2014-2015 through 2015-2016



**5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.*
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday

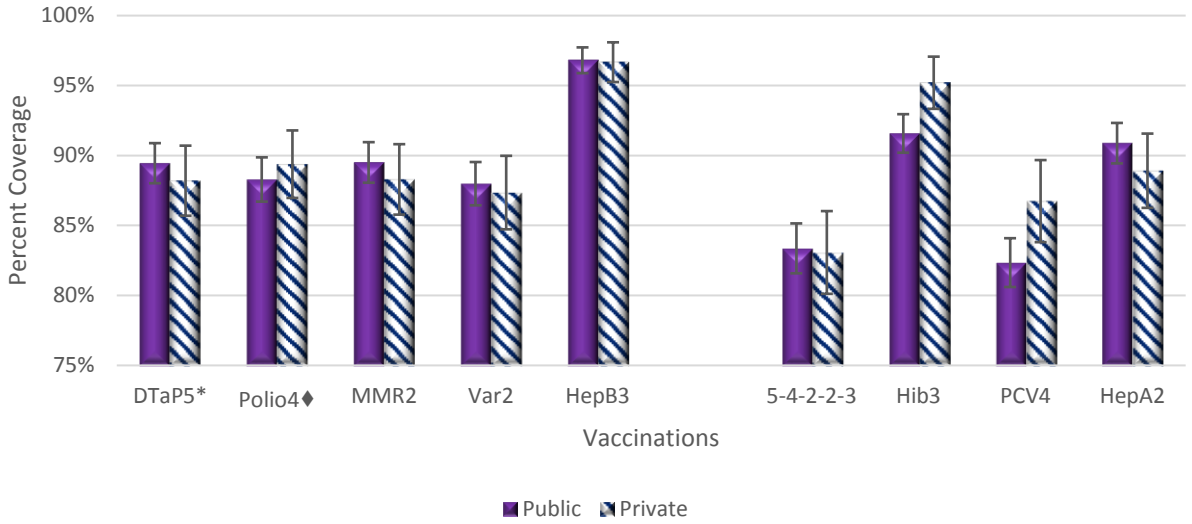
Vaccination Coverage Stratified by School Type (Public vs. Private)

There were differences observed in the vaccination coverage levels for kindergartners enrolled in public versus private schools (Figure 4). When compared to children enrolled in private schools, students in public schools had significantly higher vaccination coverage at school entry for:

- PCV4
- Hib3

There were no other significant differences in vaccination coverage observed between school types.

Figure 4: Vaccination coverage levels of Kansas kindergartners at school entry, by school type, Kansas 2015-2016



**5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.*
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday

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Vaccination Coverage Stratified by County Population Density Group

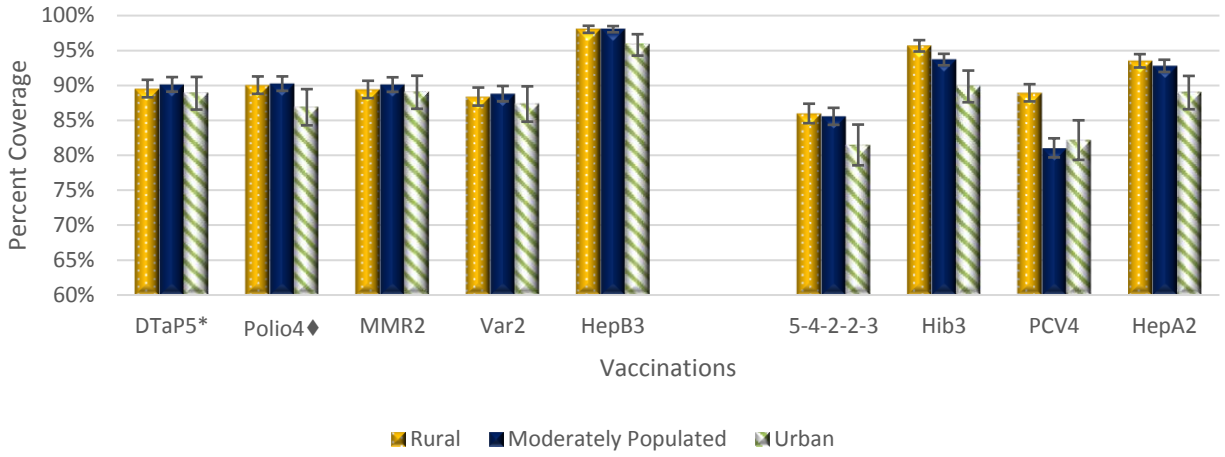
Counties were stratified by population densities, and coverage levels assessed and differences in immunization rates were observed (Figure 5). Compared to kindergarteners in less densely populated counties, students in urban counties had significantly lower coverage for:

- HepB3
- 5-4-2-2-3 vaccine series
- Hib3
- HepA2

Students in rural counties had significantly higher rates of coverage for Hib3 and PCV4. There were no other significant differences in vaccination coverage observed between school types.

Vaccination coverage was also analyzed at the county level and are listed by county name in Appendix 2. Maps of vaccine coverage by county are in Appendix 3.

Figure 5: Kansas vaccination coverage levels for kindergarten students, by county population density group, Kansas 2015-2016



**5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday*
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday

Exemption and Exclusion Policy Analysis

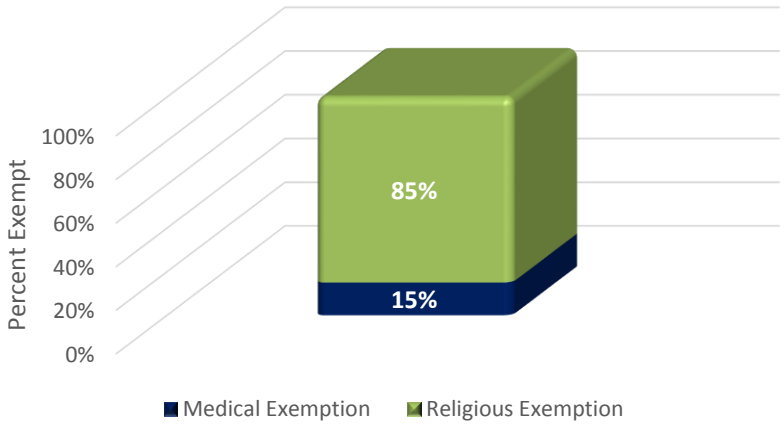
Data Collection

Of the 813 schools invited to participate, 774 (95%); 676 public and 98 private, responded to the request for information regarding exemption data. These responding schools represent all 105 Kansas counties and were included in analysis.

Kindergarten Exemptions

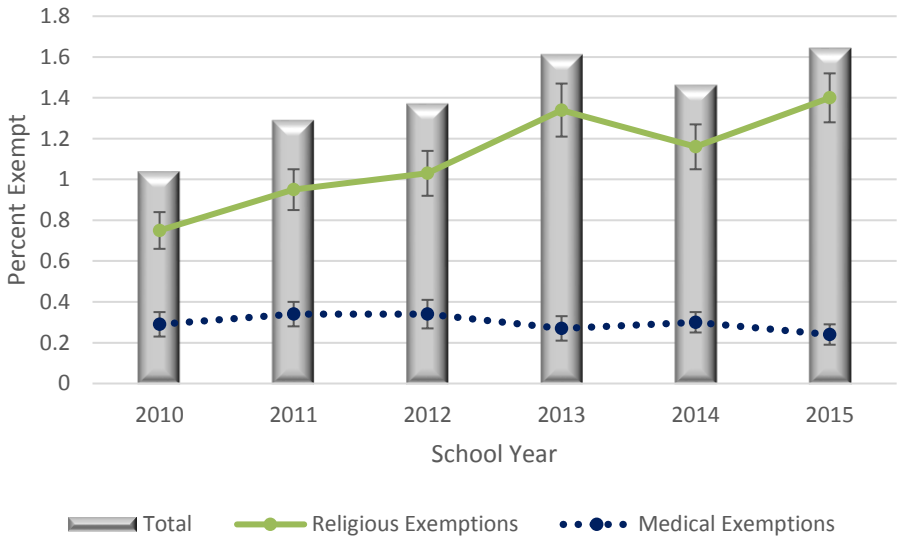
During the 2015-2016 school year, 608 (1.65%) kindergarteners from the responding schools were reported as having an exemption. Of the exemptions reported, 518 (85.2%) were categorized as religious and 90 (14.8%) as medical (Figure 6).

Figure 6: Percentage of exemptions reported by schools at kindergarten entry, by exemption type, Kansas 2015-2016



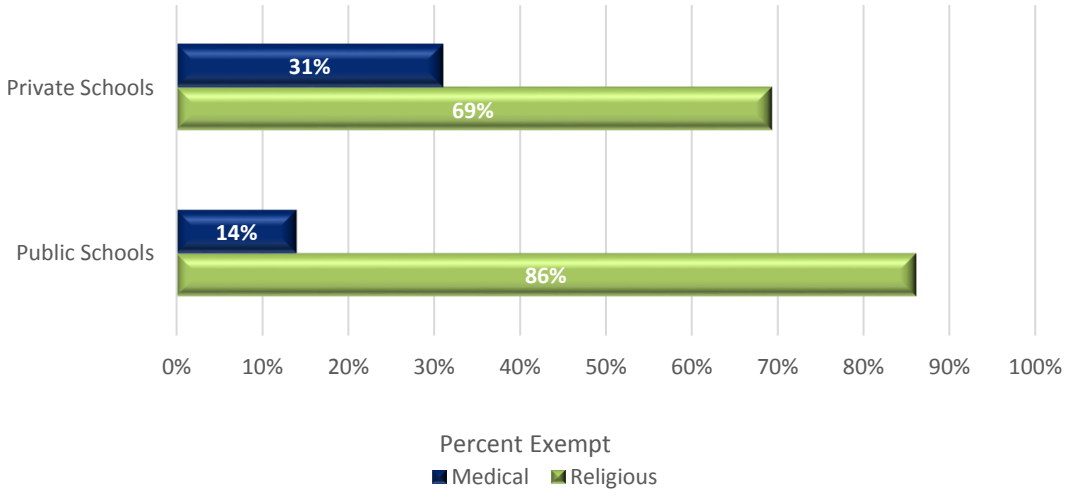
The percentage of kindergarten students reported with an exemption increased to 1.64% in the 2015-2106 academic year compared to 1.46% the previous year (Figure 7). Religious exemptions significantly increased from 1.16% in 2014-2015 school year to 1.40% in 2015-2016. Medical exemption levels have not significantly changed since the 2010-2011 school year; remaining at approximately 0.3% of the kindergarten student population.

Figure 7: Exemption rates among kindergarten students, by exemption type and year, Kansas 2010-2016



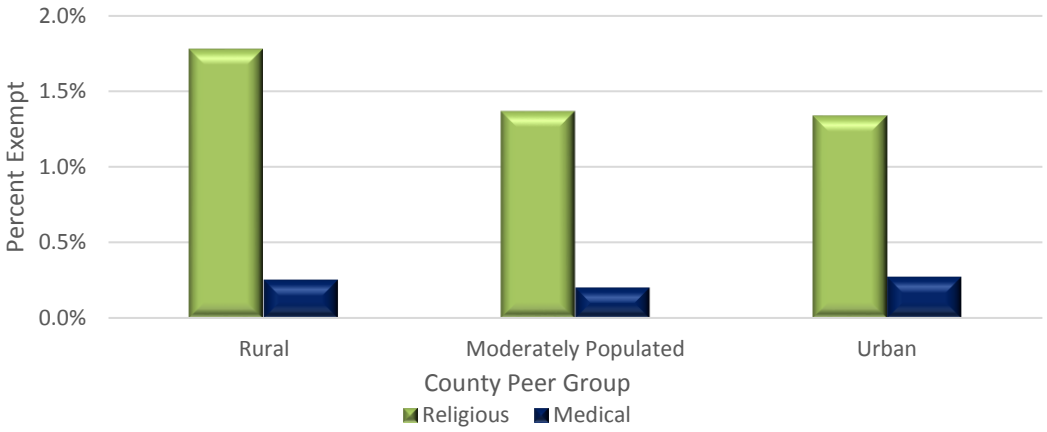
Additionally, when stratified by school type, private schools had a higher proportion of medical exemptions among their students compared to public schools, 31.3% vs. 13.9% respectively (Figure 8). Alternatively, public schools had a higher proportion of students with religious exemptions compared to private schools, 86.1% vs. 68.7% respectively.

Figure 8: Percentage of exemption by exemption and school type, Kansas, 2015-2016



Vaccine exemptions were stratified by county density groups to identify trends. The percentage of enrolled kindergarten students with religious exemptions was not significantly different among county population density categories. Kindergartners in rural counties had the highest number of religious exemptions at 1.78% (Figure 9). Maps of exemptions by county are in Appendix 4.

Figure 9: Percentage of total population of kindergarten students with exemption by county population density group and exemption type, Kansas, 2015-2016



School Exclusion Policy

Schools were surveyed about their school policies for grace periods and exclusions. KSA 72-5209, states that "every pupil enrolling or enrolled in any school for the first time in this state… shall present to the appropriate school board certification from a physician or local health department that the pupil has received such tests and inoculations as are deemed necessary." Only religious or medical exemptions to inoculations are listed as acceptable alternatives to the required vaccinations.

KSA 72-5211a gives school boards the power to "exclude any pupil until such time as the pupil has complied with the requirements" for vaccination to enter school. Schools were also asked about policies regarding grace period (time which a student may become UTD on the required vaccinations) and exclusion of non-UTD children. Of the 774 schools included in census analysis, 761 (98.3%) indicated their school's grace period and exclusion policies:

- Grace Period Policy
    - 548 (72.0%) indicated having a grace period policy
    - 129 (17.0%) indicated no grace period policy
    - 84 (11.0%) indicated the child must be UTD on the first day of school.

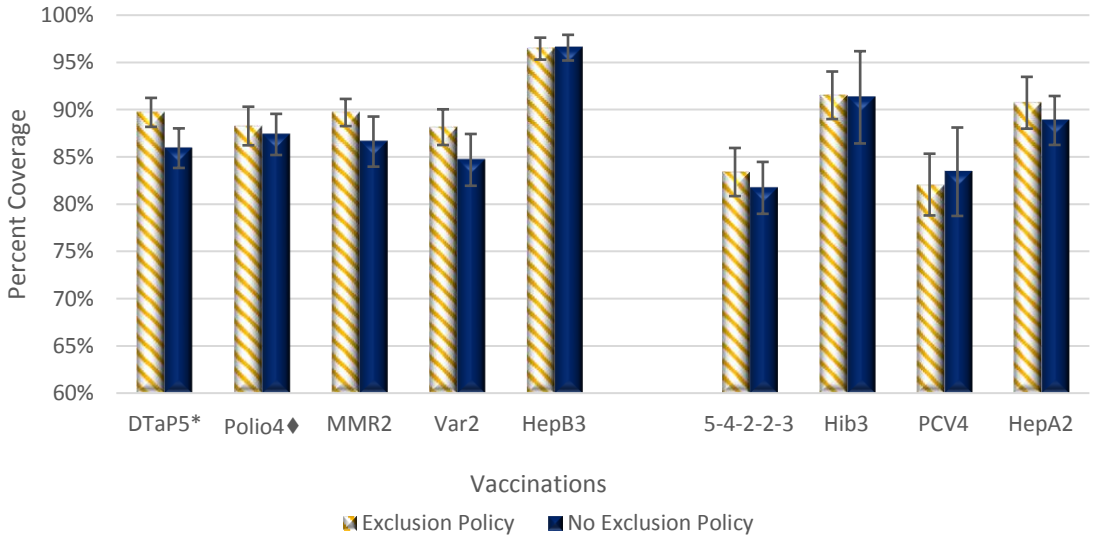
Grace periods ranged from 30 days after the first day of school to the first day of the second semester.

- Exclusion Policy
    - 546 (71.7%) reported an exclusion policy
    - 161 (21.2%) reported no exclusion policy

- 54 (7.1%) were unsure of school's exclusion policy

Exclusion policies were examined by school type; 502 (75.4%) of public schools reported having an exclusion policy, compared to 44 (46.3%) of private schools. When vaccine coverage was stratified by exclusion policy, it was observed that compared to schools that did not exclude, schools that did had significantly higher vaccination coverage for DTaP5 (Figure 10). Additionally, while not statistically significant, schools with an exclusion policy had proportionally higher levels of coverage for all vaccinations except HepB3 and PCV4.

Figure 10: Vaccination coverage of kindergarten students at school entry by vaccine and school exclusion policy, Kansas 2015-2016



Discussion

All vaccinations required for school entry were above 87% coverage for Kansas kindergarteners for the 2015-2016 school year. DTaP4, Polio3, and HepB3 met the national HP2020 metrics of at least 95% coverage, however, no required vaccinations were more than 8 percentage points from meeting this metric. Coverage in the 30 days following the start of school increased by 3% for DTaP5, MMR2, Var2, and 5-4-2-2-3 series. No increase in coverage rates were observed for HepB3, Hib3, PCV4 or HepA was noted. Hib3, PCV4, and HepA vaccines are not required for school and therefore may not be consistently recorded on the student's immunization record which may result in a possible underreporting of coverage levels. HepB3 also did not increase in this 30-day time frame due to the already high vaccination coverage levels on the first day of school.

Vaccination coverage levels between types of school (public vs. private) and counties (rural vs. moderately populated vs. urban) were compared to determine if there was a difference in coverage. Children in private schools had significantly higher vaccination coverage levels for PCV4 and Hib3. This could indicate that private schools may be collecting vaccination status for vaccines that are not required to attend school. To further explore

coverage trends, estimates were compared among counties of different population densities. It was observed that children in urban counties had significantly lower vaccination coverage rates for HepB3, 5-4-2-2-3 series, Hib3, and HepA2 compared to children in counties with lower population densities. Alternatively, rural county kindergarten students had significantly higher coverage for Hib3 and PCV4 compared to counties with higher population densities. These differences indicate that counties with higher school population density, such as urban schools with an average of 53 students per school, tend to have lower vaccination coverage compared to rural schools which have an average of 29 students per school; especially for recommended vaccinations.

Vaccination coverage levels were also compared among schools based on exemption policies to determine if excluding children who were not UTD for required vaccinations affected coverage.

Exemptions for vaccination was analyzed and it was observed that 1.6% of kindergarten students reported an exemption, of which a majority were classified as religious. These rates were an increase over the previous school year; despite the decrease in exemptions observed in 2014-2015, an overall upward trend in religious and overall exemption rates among Kansas kindergarten students has been observed since the 2010-2011 academic year. The percent of students with exemptions did not differ between schools that exclude and those that do not (1.63% and 1.62%, respectively). This indicates that exemption rates do not rise despite the exclusion policies. Exemption rates are of particular importance because when children are exempt from vaccination or not up to date they are at risk for contracting vaccine preventable diseases (VPDs) and subsequently spreading the disease to other unimmunized or under-immunized individuals (e.g., infants) or other high-risk persons. Therefore, it is important that the numbers of exempt and under-immunized school-aged children remain low. By having greater vaccination coverage, there is an increase in herd immunity, which leads to lower disease incidence and limits the size of VPD outbreaks. However, due to unvaccinated and under-immunized individuals, the United States has experienced increased incidence of disease; including measles which had previously been declared eliminated on January 1, 2000. In 2015 Kansas experienced a large pertussis outbreak that lasted nine months and included 95 cases among school-aged children (median age 8 years). It was observed that 73.4% of the cases were UTD; well below the estimated percentage of 92% - 94% needed for herd immunity to prevent disease.

Limitations

A limitation of this study is that vaccinations recommended for school-aged children are not required for school entry and may not be consistently reported on the vaccination record, creating a possible underreporting of coverage for Hib3, HepA2, and PCV4. Additionally, school personnel reported the number of exempt students in their school in aggregate, therefore KDHE was unable to verify exemptions reported. Finally, no descriptive data was collected about sex, race, or ethnicity.

While history of varicella disease may have been marked on the KCI or other vaccination record, date of disease was rarely given. Without knowing the date of disease, it cannot be definitively determined that the disease took place before the first scheduled dose of varicella containing vaccine. Children with marked history of disease,

regardless of number of varicella vaccinations were not included in analysis for varicella coverage. Of the 8,328 records analyzed, 25 (0.3%) were recorded as having disease history and removed from varicella coverage analysis.

Strengths

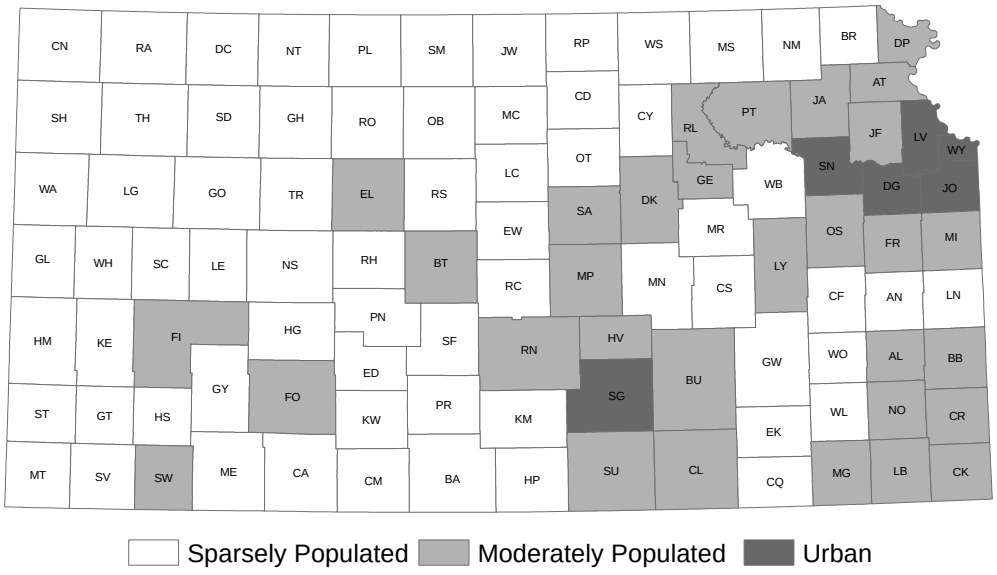
Despite the limitations, the annual vaccination survey provides a good estimation of vaccination coverage for kindergarten children enrolled in public and private schools in Kansas. This document allows state and local officials to identify counties; to focus implementation of enhanced vaccination delivery methods; and provide educational campaigns that can aid in Kansas achieving national vaccination coverage metrics. This study also had a high response rate in terms of survey participation. This included high response levels among schools that received requests for vaccination records (94%) and schools that were requested to submit exemption data only (95%).

Appendix 1: Kansas counties categorized based on population density, 2010

Sparsely Populated	
Anderson	Marshall
Barber	Meade
Brown	Mitchell
Chase	Morris
Chautauqua	Morton
Cheyenne	Nemaha
Clark	Ness
Clay	Norton
Cloud	Osborne
Coffey	Ottawa
Comanche	Pawnee
Decatur	Phillips
Edwards	Pratt
Elk	Rawlins
Ellsworth	Republic
Gove	Rice
Graham	Rooks
Grant	Rush
Gray	Russell
Greeley	Scott
Greenwood	Sheridan
Hamilton	Sherman
Harper	Smith
Haskell	Stafford
Hodgeman	Stanton
Jewell	Stevens
Kearny	Thomas
Kingman	Trego
Kiowa	Wabaunsee
Lane	Wallace
Lincoln	Washington
Linn	Wichita
Logan	Wilson
Marion	Woodson

Moderately Populated	
Allen	Jackson
Atchison	Jefferson
Barton	Labette
Bourbon	Lyon
Butler	McPherson
Cherokee	Miami
Cowley	Montgomery
Crawford	Neosho
Dickinson	Osage
Doniphan	Pottawatomie
Ellis	Reno
Finney	Riley
Ford	Saline
Franklin	Seward
Geary	Sumner
Harvey	

Urban
Douglas
Johnson
Leavenworth
Sedgwick
Shawnee
Wyandotte



Persons per Square Mile in Peer Groups
Sparsely Populated = ≤19.9
Moderately Populated = 20 – 149.9
Urban = ≥ 150.0

Appendix 2: Average school vaccination coverage levels for children at school entry for Kansas counties, 2015-2016 (percentages) [§]

COUNTY	DTaP5*	Polio4♦	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
STATEWIDE	**89%**	**88%**	**89%**	**87%**	**97%**	**83%**	**92%**	**83%**	**91%**
ALLEN	93%	96%	95%	92%	97%	90%	97%	89%	95%
ANDERSON	87%	82%	85%	87%	95%	82%	92%	85%	82%
ATCHISON	90%	91%	90%	91%	99%	87%	99%	91%	97%
BARBER	98%	96%	94%	96%	100%	94%	98%	87%	96%
BARTON	93%	91%	90%	92%	97%	88%	96%	91%	96%
BOURBON	94%	90%	95%	92%	98%	87%	95%	79%	87%
BROWN	92%	90%	90%	87%	97%	85%	97%	89%	90%
BUTLER	87%	86%	87%	87%	98%	84%	95%	85%	93%
CHASE	85%	96%	85%	81%	96%	77%	100%	92%	96%
CHAUTAUQUA	91%	91%	88%	85%	97%	85%	97%	91%	94%
CHEROKEE	91%	92%	90%	87%	100%	86%	95%	87%	90%
CHEYENNE	97%	97%	97%	89%	100%	93%	100%	93%	86%
CLARK	50%	50%	60%	50%	100%	50%	100%	100%	90%
CLAY	94%	96%	94%	94%	96%	92%	96%	94%	96%
CLOUD	76%	76%	71%	74%	98%	71%	93%	74%	86%
COFFEY	88%	89%	88%	86%	98%	79%	94%	86%	92%
COMANCHE	90%	93%	93%	87%	97%	83%	97%	70%	97%
COWLEY	88%	89%	87%	88%	98%	86%	95%	82%	94%
CRAWFORD	89%	90%	90%	89%	97%	82%	93%	64%	86%
DECATUR	83%	88%	83%	83%	92%	83%	96%	79%	92%
DICKINSON	83%	86%	84%	81%	98%	78%	93%	84%	88%
DONIPHAN	91%	93%	92%	94%	99%	91%	98%	91%	94%
DOUGLAS	87%	79%	88%	87%	93%	76%	87%	75%	88%
EDWARDS	100%	97%	100%	97%	100%	95%	95%	87%	97%
ELK	97%	100%	97%	97%	100%	97%	97%	87%	90%
ELLIS	95%	96%	95%	95%	99%	94%	99%	78%	99%
ELLSWORTH	93%	89%	92%	94%	99%	86%	96%	89%	97%
FINNEY	88%	87%	89%	80%	99%	80%	97%	86%	97%
FORD	93%	93%	93%	93%	98%	91%	96%	90%	92%
FRANKLIN	91%	88%	95%	86%	97%	73%	88%	83%	89%
GEARY	89%	86%	89%	88%	98%	84%	95%	85%	89%
GOVE	58%	67%	50%	50%	100%	50%	100%	92%	83%
GRAHAM	93%	93%	93%	90%	97%	90%	97%	97%	97%
GRANT	86%	83%	93%	90%	100%	83%	93%	90%	97%
GRAY	83%	85%	83%	84%	99%	83%	93%	92%	93%
GREELEY	91%	91%	91%	87%	96%	87%	96%	96%	96%
GREENWOOD	93%	95%	91%	92%	98%	86%	95%	91%	91%
HAMILTON	100%	100%	100%	100%	100%	100%	97%	83%	100%
HARPER	80%	88%	81%	78%	96%	76%	93%	91%	85%
HARVEY	92%	90%	92%	88%	97%	80%	98%	84%	91%
HASKELL	84%	84%	91%	87%	100%	77%	89%	68%	84%
HODGEMAN	100%	100%	100%	100%	95%	90%	95%	90%	95%
JACKSON	90%	94%	89%	90%	95%	85%	96%	91%	93%

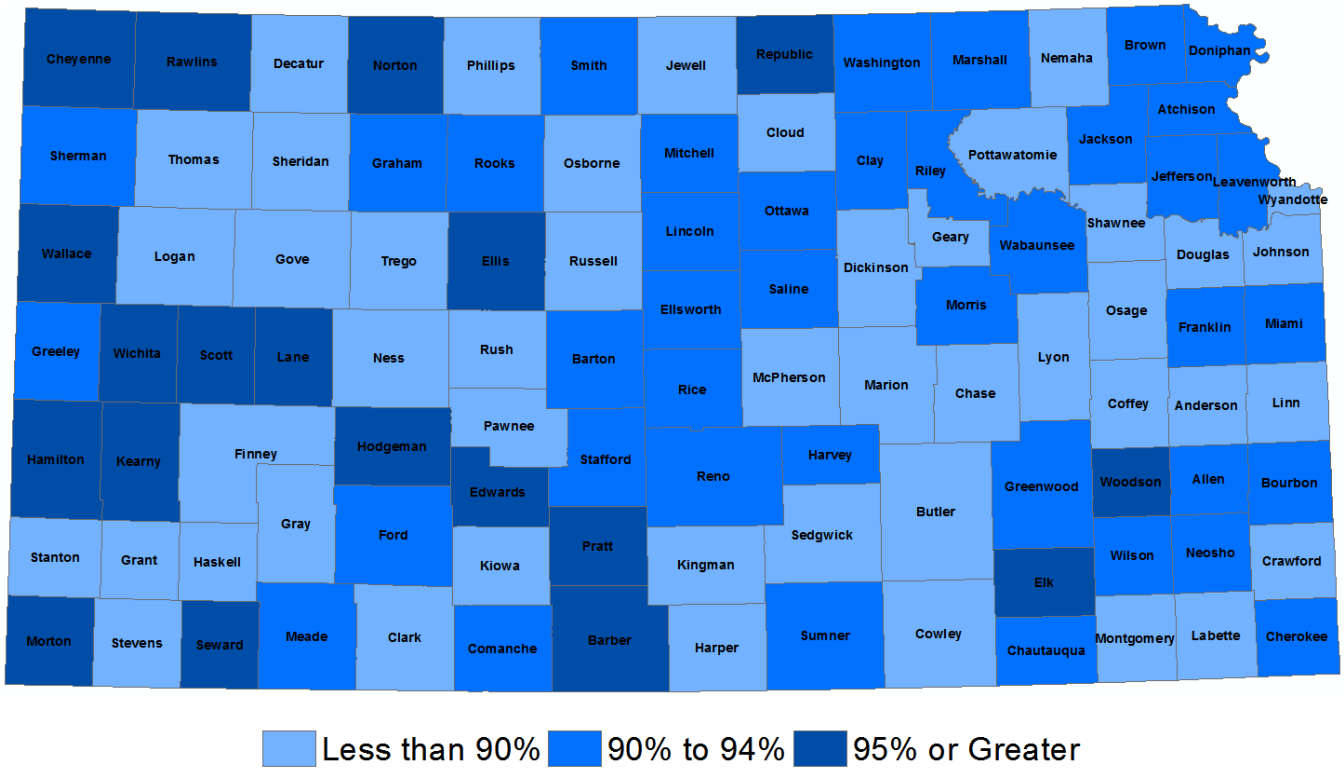
COUNTY	DTaP5*	Polio4♦	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
STATEWIDE	**89%**	**88%**	**89%**	**87%**	**97%**	**83%**	**92%**	**83%**	**91%**
JEFFERSON	93%	92%	94%	93%	99%	88%	99%	91%	94%
JEWELL	85%	85%	85%	85%	96%	85%	89%	81%	78%
JOHNSON	89%	88%	89%	87%	96%	82%	93%	84%	89%
KEARNY	96%	98%	94%	95%	100%	94%	100%	92%	100%
KINGMAN	87%	88%	87%	87%	94%	81%	93%	80%	89%
KIOWA	71%	86%	71%	71%	100%	71%	100%	100%	86%
LABETTE	89%	89%	93%	90%	98%	84%	94%	75%	91%
LANE	100%	100%	100%	100%	100%	100%	100%	100%	100%
LEAVENWORTH	93%	92%	92%	88%	98%	86%	91%	86%	95%
LINCOLN	93%	93%	93%	93%	97%	93%	97%	97%	97%
LINN	84%	85%	77%	75%	98%	70%	90%	79%	87%
LOGAN	80%	85%	80%	80%	100%	80%	98%	91%	96%
LYON	83%	91%	84%	83%	99%	80%	95%	87%	93%
MARION	86%	85%	84%	82%	94%	80%	91%	86%	86%
MARSHALL	92%	92%	92%	92%	99%	89%	98%	96%	97%
MCPHERSON	85%	87%	85%	86%	95%	81%	60%	23%	88%
MEADE	91%	94%	94%	94%	100%	91%	100%	82%	97%
MIAMI	90%	88%	88%	88%	99%	86%	64%	58%	84%
MITCHELL	93%	92%	97%	95%	98%	89%	93%	90%	95%
MONTGOMERY	85%	81%	86%	88%	99%	80%	95%	77%	96%
MORRIS	94%	96%	96%	97%	98%	94%	98%	79%	98%
MORTON	98%	98%	96%	98%	100%	96%	100%	91%	91%
NEMAHA	81%	89%	81%	83%	98%	78%	98%	91%	94%
NEOSHO	91%	94%	93%	95%	99%	89%	98%	47%	94%
NESS	45%	45%	45%	45%	100%	45%	100%	96%	100%
NORTON	98%	98%	98%	96%	100%	95%	100%	98%	100%
OSAGE	79%	80%	75%	74%	92%	74%	89%	83%	88%
OSBORNE	85%	89%	81%	81%	96%	81%	93%	93%	85%
OTTAWA	94%	93%	93%	92%	97%	93%	96%	91%	93%
PAWNEE	89%	91%	89%	90%	94%	87%	94%	89%	91%
PHILLIPS	79%	79%	79%	79%	97%	76%	100%	97%	100%
POTTAWATOMIE	85%	88%	81%	82%	94%	79%	89%	84%	90%
PRATT	98%	97%	98%	95%	98%	97%	95%	87%	95%
RAWLINS	97%	97%	97%	97%	100%	97%	93%	93%	100%
RENO	91%	92%	91%	91%	97%	89%	93%	78%	95%
REPUBLIC	97%	97%	97%	93%	93%	90%	97%	97%	97%
RICE	90%	88%	90%	91%	96%	86%	90%	85%	86%
RILEY	94%	94%	94%	93%	99%	89%	96%	88%	88%
ROOKS	94%	94%	94%	94%	100%	94%	100%	98%	100%
RUSH	89%	89%	89%	89%	100%	89%	89%	89%	100%
RUSSELL	85%	85%	85%	87%	98%	85%	98%	91%	96%
SALINE	93%	91%	93%	93%	100%	91%	97%	89%	98%
SCOTT	100%	100%	100%	97%	100%	97%	97%	97%	100%
SEDGWICK	88%	84%	88%	86%	95%	78%	91%	83%	92%
SEWARD	99%	97%	99%	98%	99%	95%	99%	86%	97%
SHAWNEE	89%	93%	92%	91%	97%	86%	98%	95%	97%

COUNTY	DTaP5*	Polio4♦	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
STATEWIDE	**89%**	**88%**	**89%**	**87%**	**97%**	**83%**	**92%**	**83%**	**91%**
SHERIDAN	89%	93%	93%	89%	100%	89%	96%	96%	100%
SHERMAN	93%	93%	93%	93%	100%	90%	100%	90%	97%
SMITH	91%	88%	91%	91%	100%	88%	100%	98%	98%
STAFFORD	91%	93%	91%	91%	100%	91%	97%	93%	95%
STANTON	80%	80%	83%	87%	93%	70%	97%	90%	100%
STEVENS	87%	87%	85%	87%	97%	82%	92%	77%	92%
SUMNER	91%	89%	88%	88%	98%	86%	92%	80%	93%
THOMAS	89%	90%	89%	88%	97%	87%	94%	90%	97%
TREGO	81%	88%	81%	75%	100%	75%	94%	94%	94%
WABAUNSEE	92%	89%	89%	87%	100%	84%	95%	89%	92%
WALLACE	100%	100%	100%	100%	100%	100%	100%	100%	100%
WASHINGTON	95%	95%	95%	97%	97%	90%	98%	90%	95%
WICHITA	100%	100%	100%	100%	100%	100%	97%	93%	97%
WILSON	93%	95%	95%	96%	99%	91%	99%	89%	96%
WOODSON	97%	97%	100%	100%	100%	97%	100%	93%	97%
WYANDOTTE	87%	88%	88%	88%	93%	77%	83%	70%	82%

§ Due to Hib3, HepA2, and PCV4 not being required for school entry, these vaccines may not consistently be reported on the vaccination record, thus decreasing coverage levels for the individual vaccines. This is evident for several counties that have extremely low levels for the Hib3, HepA2 and PCV4 coverage levels.
*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.
♦4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday.

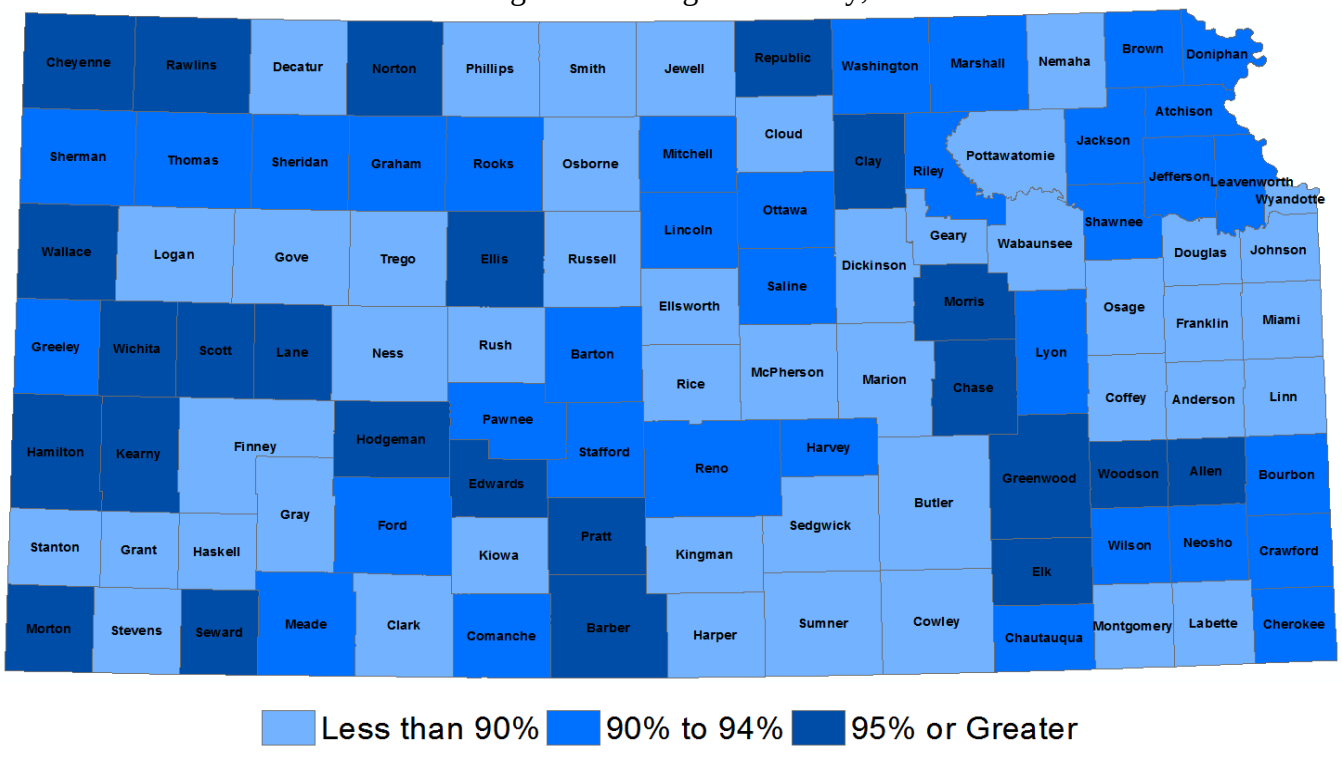
Appendix 3: Maps of vaccination levels by county, 2015-2016 Kindergarten Survey

DTaP5 Coverage for Kindergarten Survey, 2015-2016



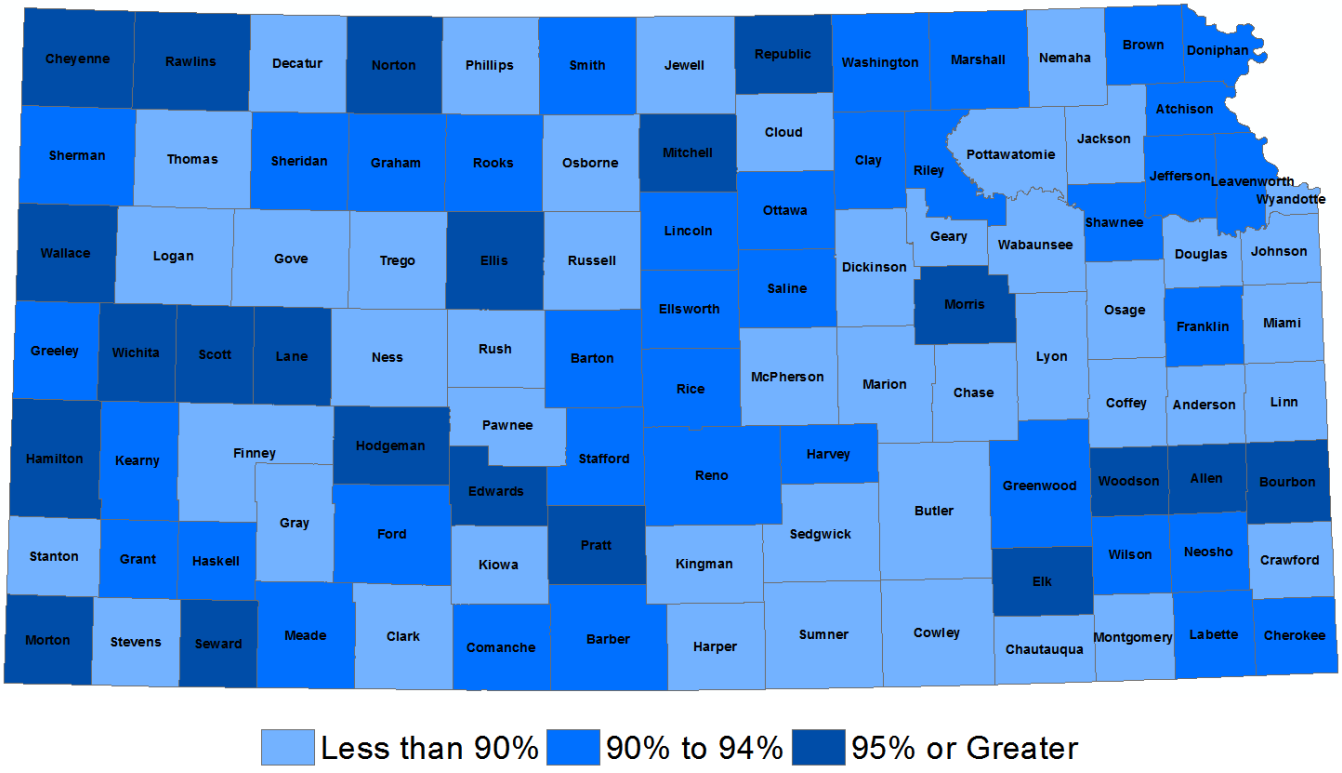
5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

Polio4 Coverage for Kindergarten Survey, 2015-2016

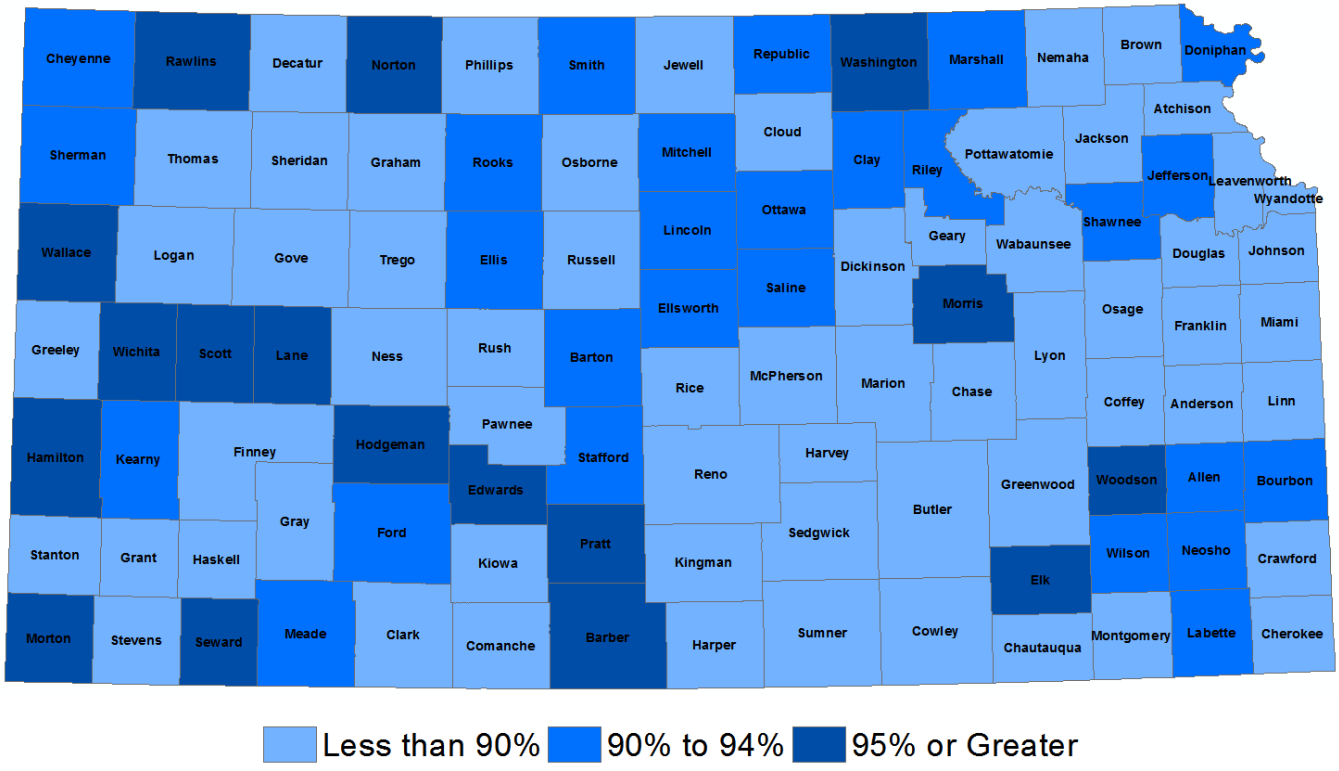


4 doses of Polio or 3 doses if 3rd is administered on or after the fourth birthday

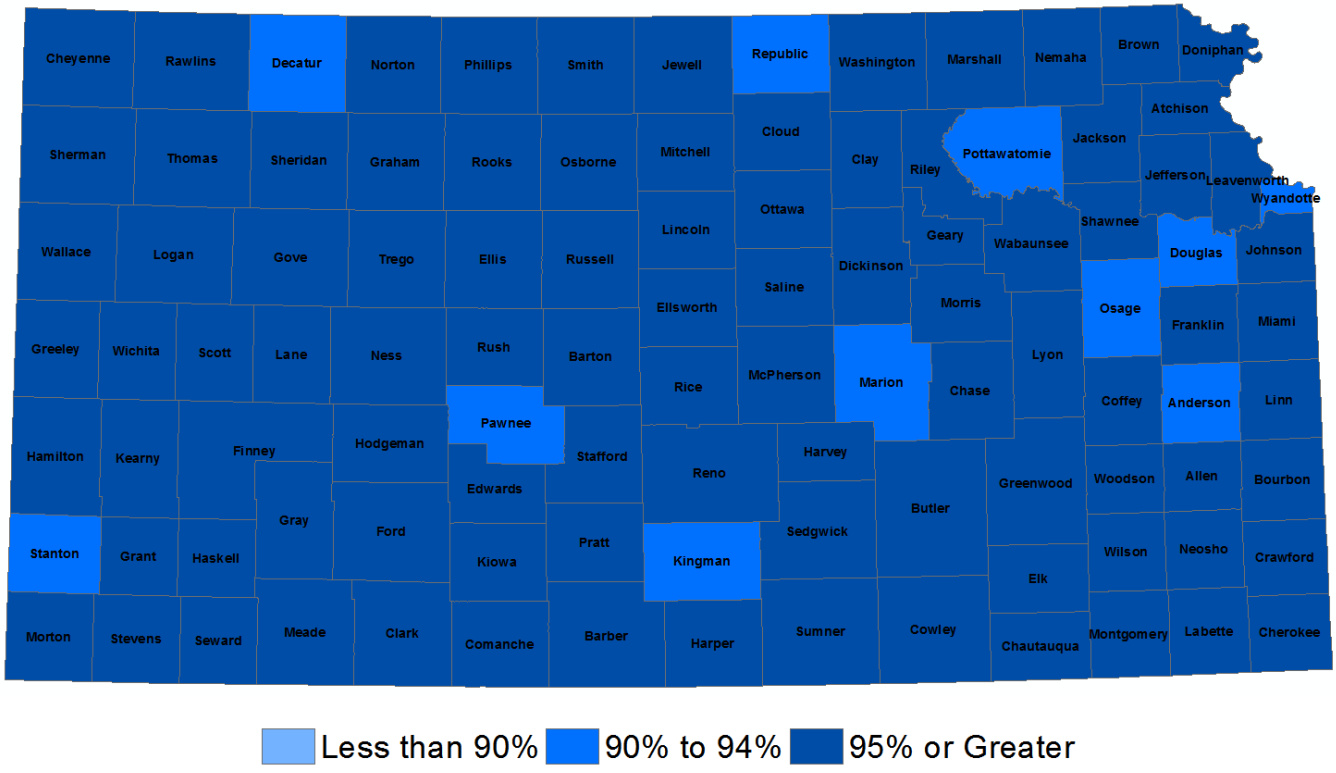
MMR2 Coverage for Kindergarten Survey, 2015-2016



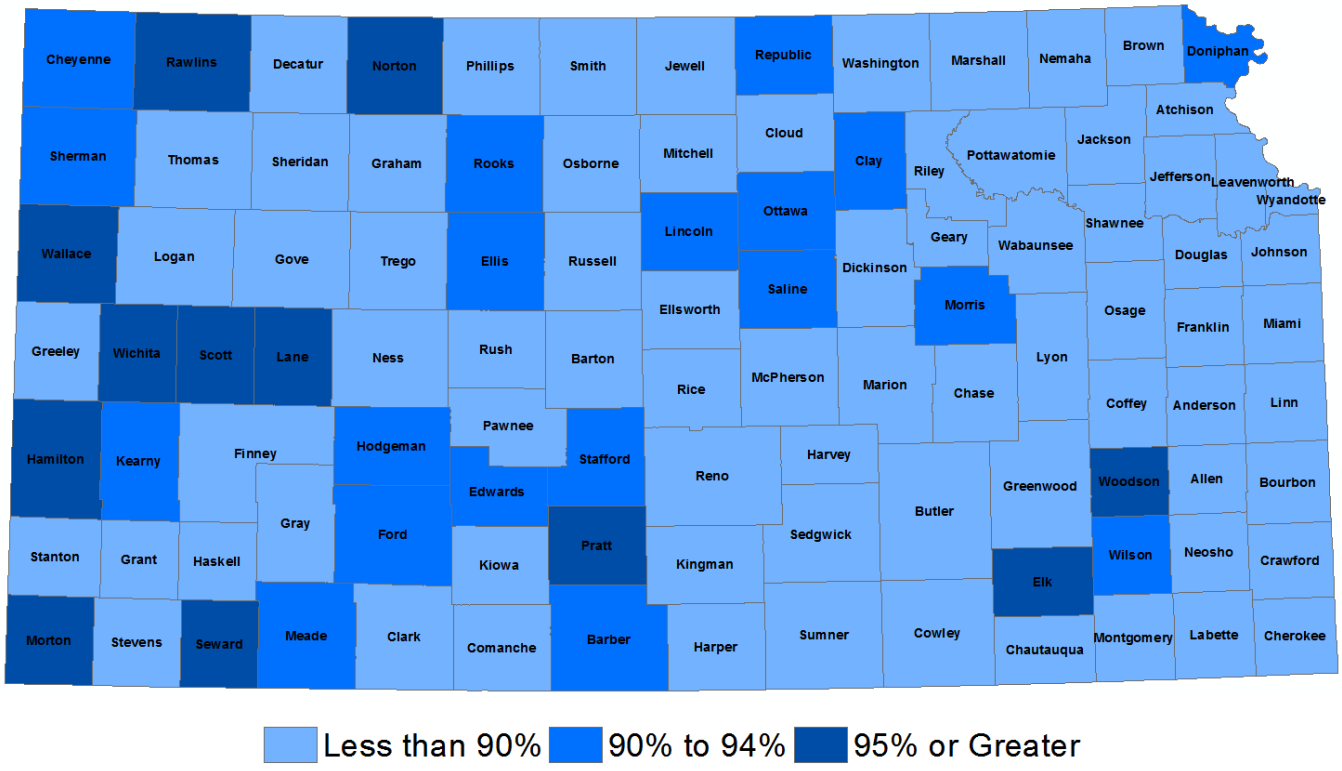
Var2 Coverage for Kindergarten Survey, 2015-2016



HepB3 Coverage for Kindergarten Survey, 2015-2016

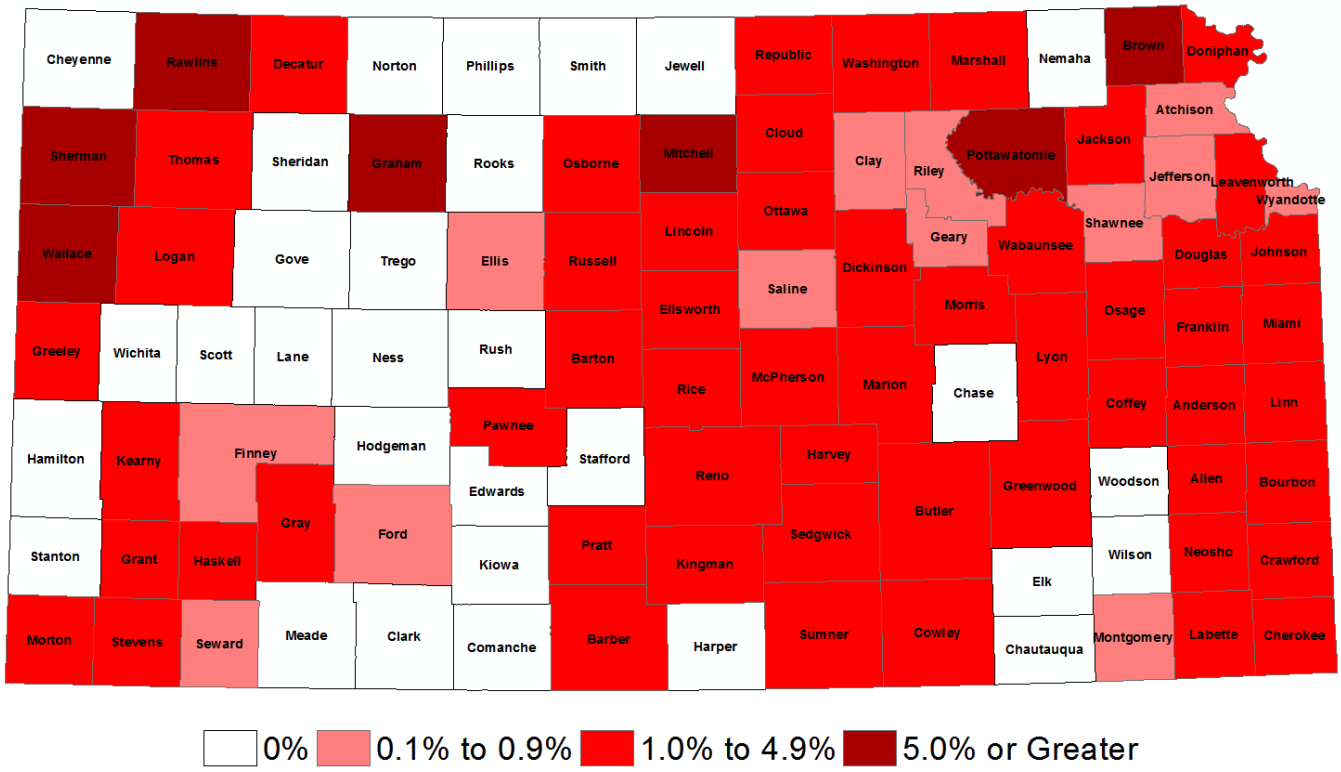


5-4-2-2-3 Coverage for Kindergarten Survey, 2015-2016



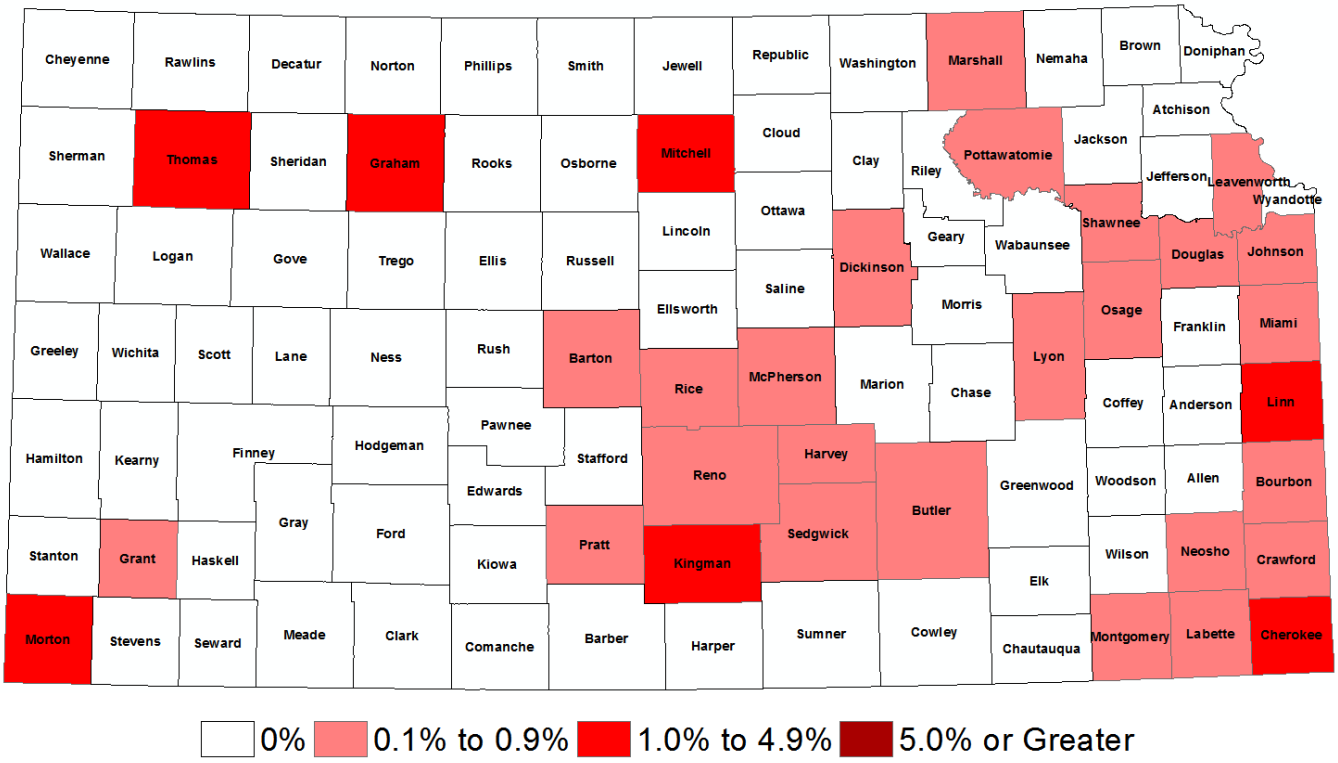
Appendix 4: Maps of exemptions by county, 2015-2016 Kindergarten Survey

Percent of Kindergartners Exempt at Submitting Schools by County, 2015-2016



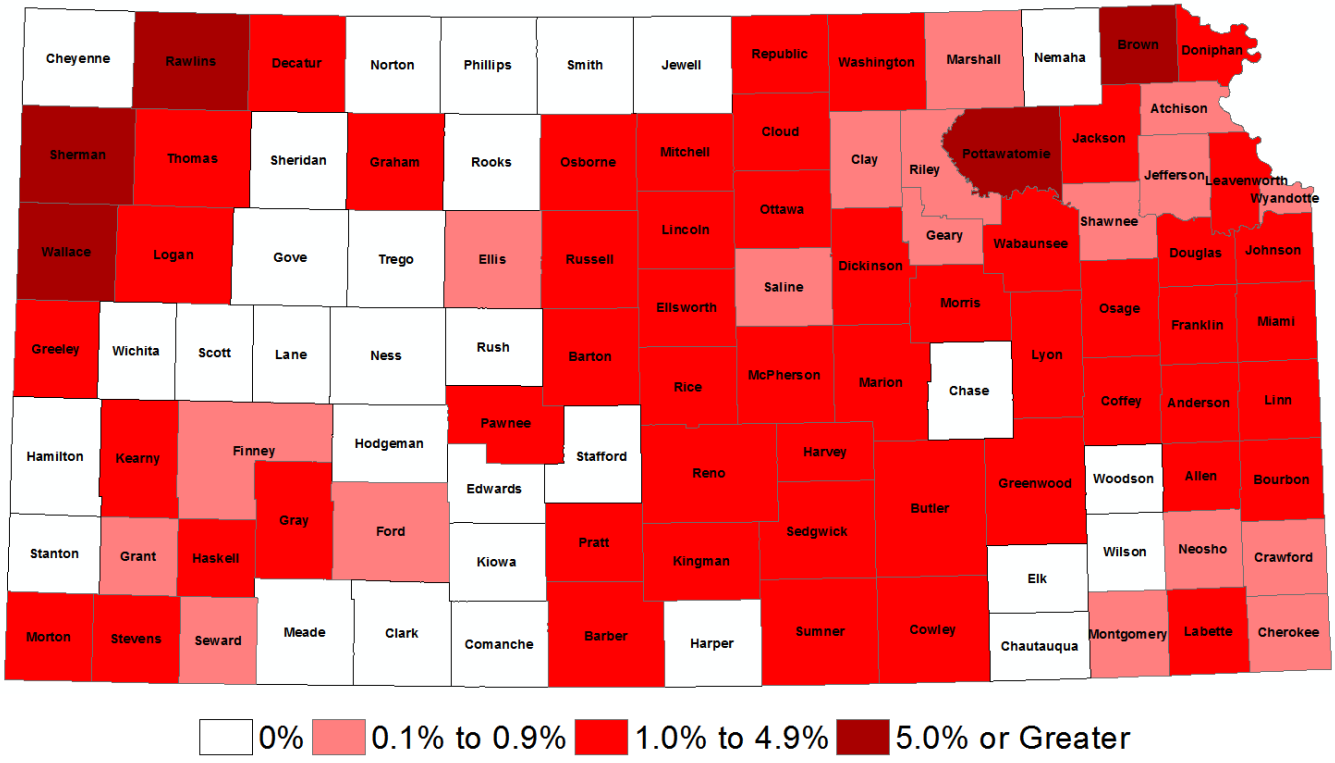
Includes children enrolled at both public and private schools

Percent of Kindergartners with a Medical Exemption at Submitting Schools by County, 2015-2016



Includes children enrolled at both public and private schools

Percent of Kindergartners with a Religious Exemption at Submitting Schools by County, 2015-2016

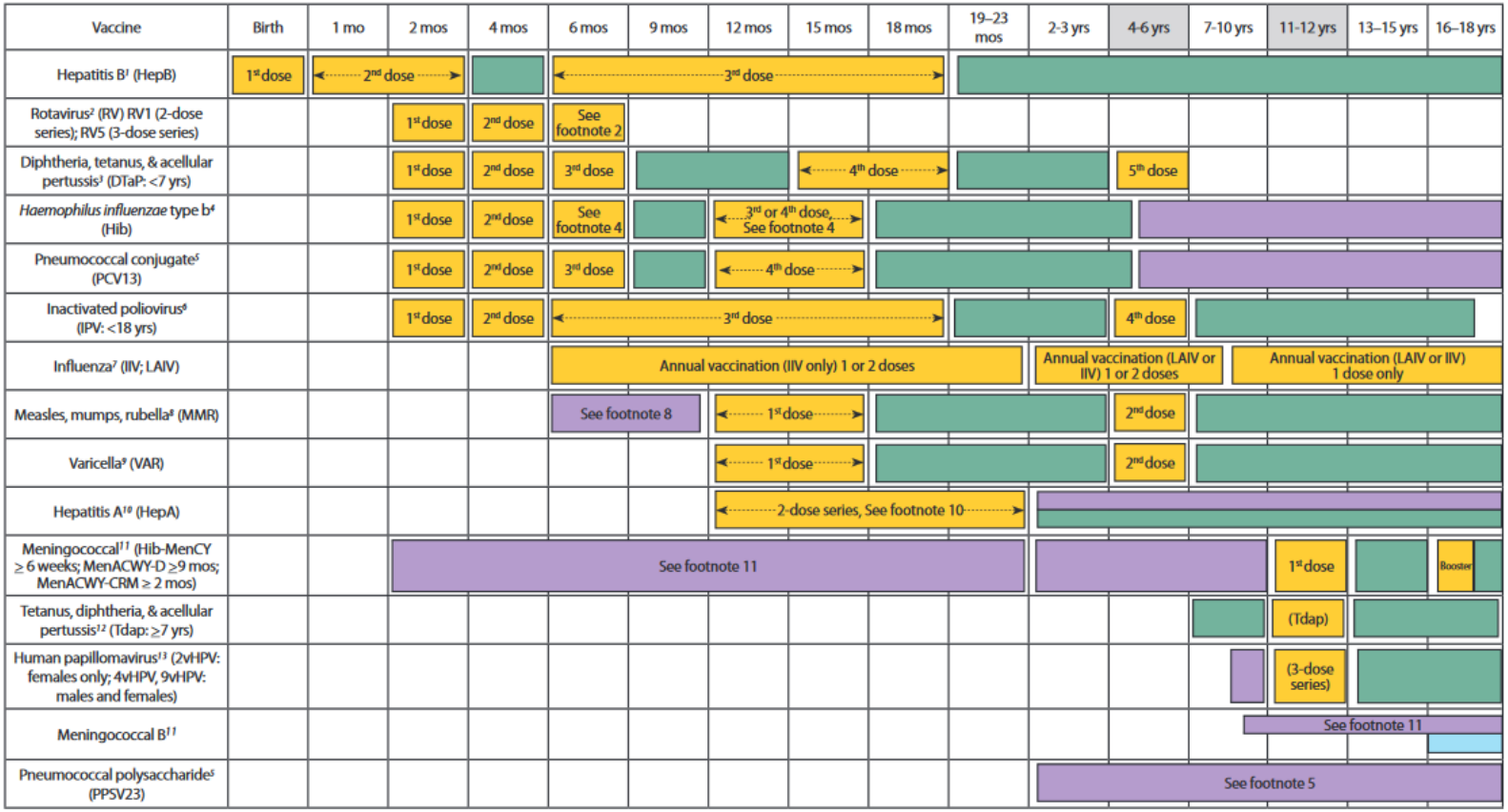


Includes children enrolled at both public and private schools

Appendix 5: CDC's 2012 Advisory Committee on Vaccination Practices (ACIP) Recommendations http://www.cdc.gov/mmwr/preview/mmwrhtml/su6201a2.htm

Figure 1. Recommended Immunization schedule for persons aged 0 through 18 years – United States, 2016.

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded.



This schedule includes recommendations in effect as of January 1, 2016. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at http://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (http://www.vaers.hhs.gov) or by telephone (800-822-7967). Suspected cases of vaccine-preventable diseases should be reported to the state or local health department. Additional information, including precautions and contraindications for vaccination, is available from CDC online (http://www.cdc.gov/vaccines/recs/vac-admin/contraindications.htm) or by telephone (800-CDC-INFO [800-232-4636]).

This schedule is approved by the Advisory Committee on Immunization Practices (http//www.cdc.gov/vaccines/acip), the American Academy of Pediatrics (http://www.aap.org), the American Academy of Family Physicians (http://www.aafp.org), and the American College of Obstetricians and Gynecologists (http://www.acog.org).